Individualized Fatigue Meter for Space Exploration, Phase II

Completed Technology Project (2009 - 2013)

Project Introduction

To ensure mission success, astronauts must maintain a high level of performance even when work-rest schedules result in chronic sleep restriction and circadian misalignment, both of which contribute to fatigue and performance deficits unless effective countermeasures are used. We are proposing to build an Individualized Fatigue Meter that incorporates light inputs, sleep history, work schedule information, and brief performance tests (e.g. PVT SelfTest) to provide immediate individualized feedback about alertness. For the past 8 years, we have been actively developing many of the system components (funded by NASA, DOD, and NIH) that can be leveraged in this project. The result of this project will be a system prototype that can be evaluated using data already being collected in space flight analog expeditions (e.g., NEEMO, HMP) and on ISS. The critical need for an Individualized Fatigue Meter has been identified as a priority outlined in the Behavioral Health and Performance Integrated Research Plan GAP 1.1.1. During Phase 2 we will build a prototype Individualized Fatigue Meter by developing: (1) an interactive graphical console; (2) a model-independent computational architecture; (3) a hybrid biomathematical fatigue model; and (4) a data fusion algorithm that statistically combines multiple inputs (Phase 2 TRL of 5-6).

Anticipated Benefits

Given the large inter-individual differences in performance vulnerability to fatigue that have been scientifically documented, an Individualized Fatigue Meter has potential commercial applications in industries where human performance is required 24/7, with precise operational constraints and important safety implications. Examples of this relevance include but are not limited to military operations, first responders, transportation workers, power plant operators, hospital personnel, manufacturing work forces, etc. Military operations, for example, involve sleep deprivation and circadian misalignment, particularly during sustained operations and/or when multiple time zones are crossed during deployment. The Army has an estimated 238,000 soldiers deployed overseas in 120 countries (source: US Army) coordinating to provide continuous global 24-7 operations. An individualized fatigue meter has the potential to provide biologically optimized work schedules and recommendations for fatigue countermeasures such as power naps, caffeine, light exposure, that will increase safety and the likelihood of successful operations.

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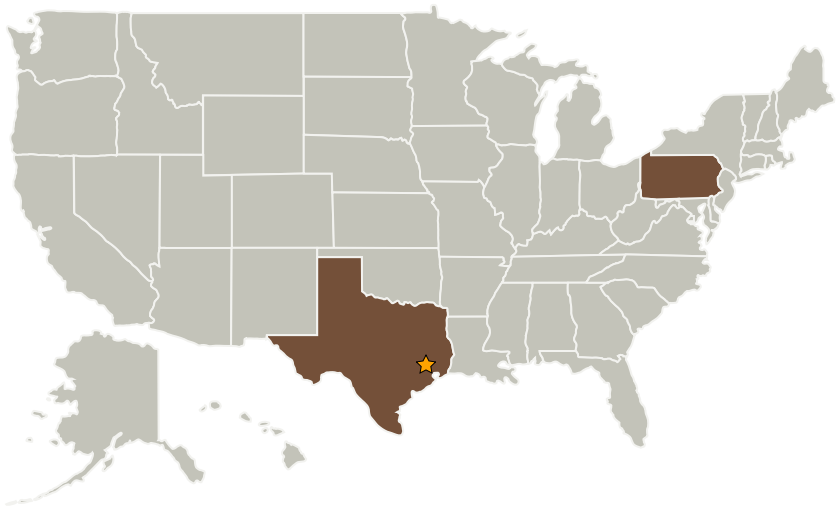
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★Johnson Space Center(JSC)	Lead Organization	NASA Center	Houston, Texas
Pulsar Informatics Inc	Supporting Organization	Industry	

Co-Funding Partners	Type	Location
Office of Naval Research	US Government	

Primary U.S. Work Locations	
Pennsylvania	Texas

Project Transitions

December 2009: Project Start

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Center / Facility:

Johnson Space Center (JSC)

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

Carlos Torrez

Project Manager:

Lauren B Leveton

Principal Investigator:

Daniel Mollicone

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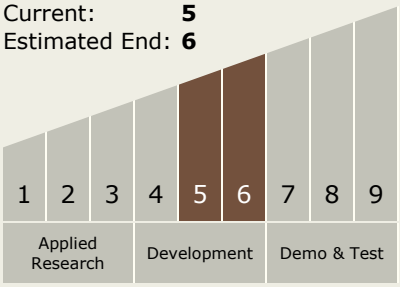
April 2013: Closed out

Technology Maturity (TRL)

Start: **5**
Current: **5**
Estimated End: **6**



Technology Areas

Primary:

- TX06 Human Health, Life Support, and Habitation Systems
  - TX06.3 Human Health and Performance
    - TX06.3.3 Behavioral Health and Performance